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PORTRAYING THE "MORNING STAR" (VENERA-9 AND -10 TELEVISION CAMERAS)

Ye. Ivanov

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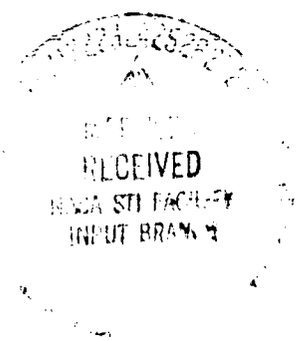

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16. Abstract

Ye. Ivanov, a design engineer, describes the difficulties associated with constructing the Venera-9 and -10 television cameras for operation on the Venus surface. A video signal was produced by direct optical-mechanical (mirror) scanning of the Venus landscape with telephotometers. Difficulties in creating an adequate seal between the glass window and the telephotometer housing are described.

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The Center of Deep Space Communications continues to track the automatic interplanetary stations "Venera-9 and "Venera-10. But this is not passive tracking. This is also control over the automatic research, collection of the scientific information, analysis and processing of the obtained data.

Involved are the antennas of the ground complex; involved are the receiving and transmitting devices, people at the control panels are intensively at work. In a word, the Earth-Venus-Earth radio bridge is in operation.

The new success of Soviet cosmonautics, attained in anticipation of the 25th Congress of the CPSU, is remarkable testimony of the scientific and technical progress of the Soviet nation, the creative enthusiasm of its workers and scientific collectives.

Today we are telling of the manner in which the designers proceeded toward this victory.

Beautiful, mysterious, covered with a dense veil... What kind of epithets have not been addressed toward Venus! And the more often has the word "cryptic" been sounded, the greater the desire to see it has been. Close by! To see it and to photograph it.

And now this has happened. For the first time in history. A photograph of a sector of the surface of the "Morning Star" has been obtained by means of a descent craft, which separated itself from the new "Venera" automatic interplanetary station and made a soft landing on the rocky (this is also the discovery of the century face.

The descent craft is not simply a "photocorrespondent" from the planet Earth. Its command assignment: extensive research of the surface, determination of its density, the chemical conposition of the atmosphere, the temperature and the pressure, the wind velocity, the illumination, etc. But in the first stage, a photographic portrait of the surface at the landing site found itself in the hands of the scientists.

In what manner was this unique photograph obtained there (tens of millions of kilometers away), where such unusual conditicns exist: pressure - 90 atmospheres, temperature - almost 500 degrees?

Soviet science, our designers and engineers, already have experience in obtaining photographic images of the moon and Mars by means of a phototelevision device. It is particularly this method that is best suited for obtaining an image in the conditions of the climate of Venus. The phototelevision device first conducts photographing on a film, then processes this film in a developer and fixer, rinses and dries it, after this by means of teletransmission it

"reads off" the image from the film...

By itself the method is simple. But... This "but" is in Venus itself. Under high temperature conditions, when each second is expensive, the conduct of all these operations at a slow rate is an impermissible luxury.

Telephotometers, scanning upwards-downwards with the little mirror, with a slow turn to the right or to the left, inspect the terrain step by step in vertical lines. The light reflected from the mirror falls onto a photoelectric cell which is illuminated more strongly or less strongly. This brings about a change of the current in the circuit of the photoelectric cell. And from then on, as they say, it is a matter of technology. More precisely, of radio engineering. It has been of the designers to wrack their brains over its development.

The telephotometers installed on the Lunniks underwent two kinds of tests: for hermeticity and for heat resistance. The scanning mirror and the turning device were situated in a housing with normal atmospheric pressure, the round cylindrical window was covered with glass. Between the glass and the housing there was created a seal which prevented the leakage of air into airless space. The supply and removal of heat was accomplished by a heat-control system.

Under the conditions of Venus everything is much more complicated. The external pressure required the use of high-strength glass capable of withstanding a load of up to 100 atmospheres, and of retaining its strength and optical

properties at a high temperature - up to 500 degrees. It was not a simple matter to create a seal between the glass and the telephotometer housing. The difficulties consisted in the fact that at a large temperature gradient (from almost zero to plus 500 degrees), microcracks would appear due to the different coefficient of linear expansion of the metal and of the glass. Incandescent air under high pressure could "burst" into the interior of the apparatus and put the entire equipment out of commission.

The designers were forced to conduct a large number of experiments for selection of the required seal that was capable of withstanding high temperature and pressure. Soft aluminum replaced annealed iron, and was in turn replaced by copper... The configuration of the grooves for the seal was changed, but success did not arrive. One material was replaced by another, the grooves acquired a most complex shape, test followed test, the conversion was even made for a seal from noble metals. And so the designers, workers, and testers worked day in and day out, month in and month out.

At the operational conferences the chief designer would repeat the phrase of the day: "What kind of result did our workers achieve?" The answer would be: "We are selecting the material for the seal, we are conducting tests - so far there is no result." And nevertheless human intellect solved this complex problem. Using a double seal from a special alloy and imparting to it an ingeniously convuluted shape, the designers achieved success. Finishing operations on the technological telephotometers and subsequent rigid tests

under pressure and high temperatures proved the correctness of the adopted decision.

But the best confirmation of correctness, of course, became the flight of the "Venera" itself, and the obtainment of the photographic portrait of the "Evening Star". And although the unique photograph of the surface of Venus is in a manner of speaking only a small volume of all the scientific information obtained today, it nevertheless makes it possible to understand in greater depth and more fully the mysteries of the existance and life of the remote planet. This is why we, the comrades of the design office which were creating the "Venera-9" and the "Venera-10" , are in such a happy mood today.

Ye. Ivanov, engineer-designer.